But Prof. Muraoka, in *Wiedemann's Annalen*, describes, as *Johanniskäfer*, a Japanese insect which undoubtedly is not the *Lampyris noctiluca*, but a luminous flying insect, very abundant at the end of June. Therefore it would be a *Luciola*, but a little larger than our famous *Luciola italica*, which appears very numerously in all Italy at the end of June.

Gemminger and Harold mention in Japan two *Luciolæ*: *Luciola japanica*, Linn., and *Luciola chinensis*, Thunb., but no kind of *Lampyris*. CARLO DEL LUNGO.

R. Liceo Galileo, Florence, Italy, July 11.

THE EVOLUTION OF STELLAR SYSTEMS.[1]

ABOUT a century ago Laplace presented to the world an hypothesis concerning the mechanics of the heavens, basing it on sound dynamical principles, and working it out with that genius which he alone at that time could bring to bear. This hypothesis, grand and general as it was and still is, has made his name familiar to every student of astronomy of to-day; and the equipment of a modern observatory enables us to observe more minutely the stellar systems (which he could not see, but only imagine), and wonder at his far-reaching mind in expounding such a simple scheme of evolution for them. Modern investigations have necessitated, however, a modification of Laplace's original hypothesis. In his time the view was held that figures of equilibrium of rotating bodies were necessarily surfaces of revolution about the axes of rotation, but thanks to the mathematical researches of Jacobi, Darwin, Poincaré, &c., this is found now not to be universally true. To-day, for instance, if we consider the revolution of two separate fluid masses so close to one another that they are caused to coalesce and form a rigid system, through tidal distortions, then the form of the resulting mass will be dumb-bell shaped, approximating to Poincaré's apioid. It is regarding the mutual reaction of two such bodies as these that the author of the volume under consideration has recently made mathematical investigations, and he has not limited himself to the purely mathematical side of the problem, but has extended the view to the stars in space, which according to the ideas now held are not solid bodies, but masses of matter in which tidal action can have full play. It seems exceedingly probable, he says, "that the great eccentricities now observed among double-stars have arisen from the action of tidal friction during immense ages: that the elongation of the real orbits, so unmistakably indicated by the apparent ellipses described by the stars, is the visible trace of a physical cause which has been working for millions of years. It appears that the orbits were originally nearly circular, and that under the working of the tides in the bodies of the stars they have been gradually expanded and rendered more and more eccentric."

Dr. See, in the first of the three chapters which composes this volume of more than 250 pages, gives a short historical sketch of double-star astronomy from the time (1779) of Sir William Herschel down to that of Mr. Burnham. The next three sections are devoted to the solution of several problems referring to Laplace's demonstration of the law of attraction in the planetary systems, investigation of the law of attraction in the stellar systems and the analytical solution of Bertrand's problem based on that developed by Darboux, together with the solution given by Halphen. The three following sections treat of problems which Dr. See has previously published in the *Astronomischen Nachrichten*. In the first of these he develops the theory by which, by a simple spectroscopic observation, the absolute dimensions, parallaxes, and masses of stellar systems may be immediately ascertained assuming the orbits are known from micrometrical measurement. In a later chapter he points out how this method may be applied to the best-known doubles. Those most suitably situated for such measurements of relative motion are: η Cassiopeæ, α Canis Majoris, 9 Argûs, ξ Boötis, γ Coronæ Borealis, Σ 2173, 70 Ophiuchi, β Delphini, and α Centauri. The second section gives us a means of rigorously testing the law of gravitation by comparing the observed motion in the line of sight of a companion with the theoretical value.

Sections 8–12 are devoted to a survey of the chief methods of determining the orbits of binary stars. Among these attention may be drawn to a very simple graphical process of finding the apparent orbit from the given elements. Dr. See also properly brings to the fore that admirable graphical method of solving Kepler's equation which was originally invented by J. J. Waterson, and subsequently rediscovered by Dubois. This method, which Klinkerfues describes in his treatise on theoretical astronomy, and which is used by many continental astronomers, is suited to ellipses of all eccentricities, and can be applied, by the addition of a simply determined correction, to the orbits of comets and planets, giving all the accuracy required.

As regards chapter ii. much could be written, since this part of the volume extends over 178 pages out of the 258, and is of great importance. The author has brought together the detailed researches on the motions of the forty stars whose orbits can be best determined at this epoch. For the completion of this work Dr. See has been able to obtain measurements by double-star observers which have not been previously published, and by this means he has carefully determined independently the orbits of these forty doubles, a piece of work which must have involved an immense amount of labour. In the case of each binary are given the observed measures up to date, the previously determined elements and his own elements, and a comparison of the observed with the computed places. There further follow an ephemeris up to the year 1900, and sometimes up to a later epoch, general remarks on the binary in question, and in each case a plate showing the apparent orbit and the positions of the observed companion.

As an illustration of one of the orbits, we may mention that of 70 Ophiuchi, as this is of special interest since the motion of the comparison indicates that a third body is probably in question. Several investigators have worked out the orbit of this double, but there seems always to have been a certain amount of dissatisfaction about the resulting ellipse. The figure shows very clearly the wavy line of motion of the observed with the computed position. Prof. Schur, who made a most rigorous investigation of this binary in 1868 and 1893, discussing 400 observations in the latter year, inspired the belief that at length a definite orbit was obtained, but subsequent comparison of the observed with the computed positions indicated that there must probably be an unseen body disturbing the elliptic motion. Prof. Burnham, who has specially searched for this third perturbatory body, has as yet failed to see it, although he has used the 36-inch Lick refractor in the attempt.

Coming now to the third and last chapter, Dr. See sums up the results of the researches on these forty binaries. A general glance at the table shows that the elements T, a, ☊, i, λ have no relation to physical causes; but, in the case of the eccentricities, "a most remarkable law" is established, which is "of fundamental importance in our theory of the origin and development of the stellar systems, and is besides of practical value to working astronomers." Perhaps the following table will best show the number of orbits corresponding to different eccentricities:—

[1] "Researches on the Evolution of the Stellar Systems. Vol. i. On the Universality of the Law of Gravitation and on the Orbits and General Characteristics of Binary Stars." By T. J. J. See, A.M., Ph.D. (Lynn, Mass, U.S.A.: The Nichols Press, 1896.)

Eccentricities between	No. of orbits.
0·0 and 0·1	0
0·1 ,, 0·2	2
0·2 ,, 0·3	4
0·3 ,, 0·4	8
0·4 ,, 0·5	9
0·5 ,, 0·6	9
0·6 ,, 0·7	2
0·7 ,, 0·8	4
0·8 ,, 0·9	2
0·9 ,, 1·0	0

Mean average value of the eccentricity of the forty binaries, 0·482.

The author thus points out that binaries are distinguished from the planets and satellites in two very distinct respects, namely:

(1) The orbits are highly eccentric.

(2) The stars of a system are comparable, and frequently almost equal in mass.

Dr. See gives a series of illustrations of the orbits arranged in the order of their eccentricity, and remarks that while these are more eccentric than those of the planets and satellites, they are much less eccentric than those of the long-period comets.

The reason why these orbits came to be so eccentric the author evidently leaves to a second volume, as he says that hereafter we shall see that the orbits were originally circular.

In Dr. See's concluding remarks, he points out that these double systems stand in direct contrast to the planetary systems, in which the masses of the components are not in the proportion of two to one, or equal, but where the central body has 746 times as much mass as all of the planets combined.

It is true that investigators, as Dr. See remarks, have always approached the problems of cosmogony from the point of view of our solar system, and have not given sufficient attention to systems of the double or triple star type. This is probably owing to the fact that double star astronomy is practically very modern, and that those investigators were not aware that the telescope would reveal such innumerable systems of double and triple stars as we now know to exist in the heavens. It is further natural that we should consider our system in the first instance a common type of the celestial ones, until it is proved on the contrary to be otherwise. Indeed, such a system as ours need not be in any case an exceptional one in space; looking at a similar one in the heavens, we should most probably only be able to see the central body the sun, in consequence of the smallness of the components (the planets) revolving round it.

It seems likely that such a system would be more easily observed when in the nebulous stage, as, for instance, in those spiral nebulæ which have central nuclei very large compared with the smaller condensations scattered along the outliers.

In conclusion, we may say that we have nothing but praise for this book. By its publication double-star astronomy is greatly enriched, and every double-star observer and computer will find it a valuable addition to his library.

Not only will the exposition of the modern methods of computation of such systems add greatly to its usefulness, but a mine of valuable information regarding the previous researches on the best-known members of double-star systems is brought together in one volume.

WILLIAM J. S. LOCKYER.

THIERRY WILLIAM PREYER.

TO our readers the announcement of the death of this distinguished physiologist will come with surprise. To those who knew Preyer it might have seemed as if he, with that appearance of overflowing vigour, might have looked forward to a long lease of life. It was otherwise, for Preyer died at the comparatively early age of fifty-six of Bright's disease.

Preyer was born in Manchester in 1841, and, after studying in London, he, like most German students, attended several universities, including Bonn, Berlin, Vienna, Heidelberg, and Paris. In 1862 he took the degree of Doctor of Philosophy and that of Doctor of Medicine in Bonn in 1865. In Bonn he was brought under the influence of Max Schultze; in Berlin Helmholtz, Du Bois, and Virchow inspired him with a desire to become a physiologist, while later he worked under Bernard in Paris.

He commenced his independent scientific career as a "privat docent" in Bonn in 1865, and shortly afterwards, in 1869, he was appointed Professor of Physiology in Jena, where his best work was done.

His energy was unbounded, his enthusiasm unquenchable, and so he set to work and had erected the well-known physiological institution in Jena, where he remained until a few years ago, when he resigned his chair, and went to Berlin, where he remained some time, and then retired to live in Wiesbaden.

Preyer's name will always remain associated with his work on hæmoglobin, a work inspired partly by the researches of the Berlin School. The many-sided view of his genius found its expression in the very diverse subjects in which he worked and wrote.

His well-known work "Die Seele des Kindes" (1882) was a study of the mental development of his own child; it amplified and extended the less extensive observations of Darwin.

In the 'seventies his researches were chiefly acoustical, and to-day there exists in the Jena Institute an extraordinary collection of acoustical apparatus which he used for his researches.

About the same time (1877) he published his researches on the cause of sleep.

His "myophysical law" was not so well received by physiologists. Many of his papers and those of his pupils are published in his "Sammlung Physiologischer Abhandlungen" (1876-80), in which will be found his most interesting observations on hypnotism and an allied subject which he called "Kataplexie." Whatever may be thought of his theory, his observations stand, and only this year Verworn, of Jena, has again taken up the subject, and published some most interesting results of "Kataplexie" in serpents. Perhaps Preyer's attention was directed to hypnotism by the works of Braid, of Manchester, which he translated.

As showing the peculiar character of Preyer, and illustrating his never-ceasing quest after something new, we have his physiology of the embryo, which has been translated into French.

Preyer had a ready pen, he was a charming and attractive lecturer, and some of his popular discourses have had a wide circulation.

One of the most pleasantly written of his works is his "Elements of General Physiology," in which he gives a rapid, bold, and characteristic sketch of the development of this subject. This work was also translated into French.

Preyer was the very personification of buoyancy and good humour, and he had an open, frank expression which won for him friends on every hand. He visited England frequently, and those who heard him discourse at the Edinburgh meeting of the British Association are not likely to forget the intense impression he made on his audience, not only by the extraordinary array of facts with which he dealt, but also by the ease and fluency with which he spoke English. Preyer had many of the gifts of an orator, and when his perfervid temperament was roused he carried his audience with him and brought conviction to their minds by the very ardour and force of discourse.